

Photochemical Regulation of Stratospheric Ozone: Constraints from  
Recent Aircraft, Balloon, and Satellite Observations

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A photochemical model constrained by observed concentrations of long lived radical precursors, aerosol surface area, and environmental factors (i.e., ozone column, albedo, profiles of aerosol extinction) is used to examine our understanding of the height, latitude, seasonal, and aerosol surface area dependence of the concentration of hydrogen, nitrogen, chlorine, and bromine radicals, the photochemical loss rate of ozone, and the balance between photochemical production and loss of ozone (McElroy et al., 1992; Salawitch et al., 1994a,b; Wennberg et al., 1994). The model provides a framework for interpreting measurements of dozens of gases and related quantities (i.e. aerosol surface area and albedo) obtained during recent ER-2 expeditions (AASE, AASE 11, SPADE, and ASHOF/MAESA), balloon deployments of the FIRS (Far Infrared Spectrometer) and BMIS (Balloon Microwave Limb Sounder) instruments, and recent observations obtained by ATMOS (Atmospheric Trace Molecule Spectroscopy Experiment) and SAGE 11 (Stratospheric Aerosols and Gas Experiment).

Our analysis of measurements obtained during SPADE revealed more efficient catalytic removal of ozone by hydrogen and halogen radicals than predicted by models using recommended rates and cross sections (Salawitch et al., 1994a; Wennberg et al., 1994) and discrepancies in our understanding of the partitioning of NO and NO<sub>2</sub> and of HCl and other inorganic chlorine species (Jaegle et al., 1994; Webster et al., 1994). Models allowing for revised values of the quantum yield of O(1D) from photolysis of O<sub>3</sub>, temperature dependent absorption cross sections for HNO<sub>3</sub>, and heterogeneous decomposition of HNO<sub>4</sub> to form HNO<sub>2</sub> were shown to provide an excellent description of the observed variation of hydrogen, nitrogen, and chlorine radicals with solar illumination, although discrepancies persist between theoretical and observed HCl (Salawitch et al., 1994b). The rapid heterogeneous hydrolysis of BrNO<sub>3</sub> provides sufficient build-up of HOBr to also account for the anomalous rise of OH and H<sub>2</sub>O observed during sunrise.

Our talk will focus on recent advances in our understanding of the partitioning of radicals and reservoir species of the hydrogen, nitrogen, and chlorine family gained from observations obtained during the ASHOF/MAESA field campaign and the recent flight of ATMOS. In addition, we will comment on observations of ClO, HOCl, ClONO<sub>2</sub>, OH, H<sub>2</sub>O, NO<sub>2</sub>, and O<sub>3</sub> obtained from ATMOS and a simultaneous deployment of FIRS and BMIS that demonstrate production and loss rates of ozone nearly balance at an altitude of 38 km, reconciling a long standing discrepancy in stratospheric chemistry (Jucks et al., submitted, 1995).

#### References

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